

*Michael Hvidsten
Gustavus Adolphus College*

Exploring Geometry - Web Chapters



Contents

CHAPTER 11 ■ Universal Foundations	1
11.1 INCIDENCE GEOMETRY	2
11.2 BETWEENNESS GEOMETRY	4
11.3 PROJECT 19 - ANGLES AND RAY BETWEENNESS	15
11.4 TRIANGLES AND BETWEENNESS	20
11.5 CONGRUENCE GEOMETRY	23
11.5.1 Triangle and Angle Congruence Results	25
11.5.2 Segment and Angle Ordering	28
11.6 PROJECT 20 - ANGLE ORDER	33
11.7 CONSTRUCTIONS	39
11.7.1 Constructions	39
11.8 SEGMENT MEASURE	44
11.9 ANGLE MEASURE	56
11.10 CONTINUITY	63
11.11 TRANSFORMATIONS	64
11.11.1 Congruence Transformations	65
11.11.2 Reflections	69
CHAPTER 12 ■ Foundations of Neutral Geometry	75
12.1 TRIANGLES AND PARALLELS	75
12.1.1 Exterior Angle Theorem	75
12.1.2 Triangles — Angles and Sides	78
12.1.3 Transversals and Parallels	83
12.2 CONTINUITY REDUX	88

CHAPTER 13 ■ Foundations of Euclidean Geometry	101
13.1 PARALLEL	101
13.1.1 Parallelograms	103
13.2 SEGMENT MULTIPLICATION AND SIMILARITY	107
13.3 AREA	114
CHAPTER 14 ■ Foundations of Elliptic Geometry	135
14.1 AXIOMS OF INCIDENCE	136
14.2 AXIOMS OF SEPARATION (BETWEENNESS)	136
14.3 ORIENTATION, RAYS, AND ANGLES	147
14.4 AXIOMS OF CONGRUENCE	156
14.5 CONSTRUCTIONS AND DEDEKIND'S AXIOM	160
CHAPTER 15 ■ Foundations of Projective Geometry	171
15.1 AXIOMS OF PROJECTIVE GEOMETRY	171
15.2 HOMOGENEOUS COORDINATES AND TRANSFORMATIONS IN THE REAL PROJECTIVE PLANE	186
15.2.1 Transformations	187
15.3 PROJECT 21 - INTRODUCTION TO CONICS	193
15.3.1 Euclidean Conic Sections Generated by Isometries	193
15.3.2 Projective Conic Sections Generated by Projections	201
15.4 CONICS AND TANGENTS	204
15.4.1 Point and Line Conics	205
15.4.2 Tangents	209
CHAPTER 16 ■ Complex Analytic Functions	213
16.1 THE COMPLEX PLANE	213
16.1.1 Polar Form	214
16.1.2 Complex Functions	215
16.1.3 Analytic Functions and Conformal Maps	218

CHAPTER 17 ■ Hyperbolic Transformations	225
17.1 MÖBIUS TRANSFORMATIONS	228
17.1.1 Fixed Points and the Cross Ratio	228
17.1.2 Geometric Properties of Möbius Transformations	230
17.2 ISOMETRIES IN THE POINCARÉ MODEL	234
17.3 ISOMETRIES IN THE KLEIN MODEL	239
17.3.1 Mini-Project - The Upper Half-Plane Model	243
17.4 WEIERSTRASS MODEL	245
17.5 MODELS AND ISOMORPHISM	246
References	253
Index	255

